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MODERN CONCEPTS OF CARDIOVASCULAR DISEASE

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Spatial Vectorcardiography (II)*†

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VALUE OF VECTORCARDIOGRAPHY

The vector concept and spatial vectorcardiography have made a twofold contribution. Vectorcardiography has become: (1) the method of choice for teaching clinical electrocardiography; and (2) a valuable diagnostic tool, as an adjuvant to clinical electrocardiography, mainly through its graphic presentation of phase relationships not presented in conventionally recorded electrocardiograms. The vector concept is unitarian, treating all electrocardiographic leads as derivations of the spatial cardiac vector. These are to be viewed as projections of the spatial cardiac vector upon the lead lines of derivation. Its basis is the dipole theory, as first proposed in its elementary form by Einthoven. The evidence presented in recent years in support of the dipole theory is most convincing.

The unitarian character of the vector concept allows the presentation of all electrocardiographic leads to be related to each other as derivatives of the single spatial cardiac vector. The memorizing of patterns and configurations with such a mode of teaching is no longer necessary. The cardiac vector contains all the information about the balance of forces at each instant. This balance is well established for the normal heart, showing great consistency in its basic characteristics with few and minor variations. The considerable variability of the normal electrocardiogram is due to the fact that a normal spatial cardiac vector will produce differing projections through even minor changes of its spatial position in relation to the fixed lines of lead derivations. Normalcy is presented through the spatial cardiac vector in a simple way, while electrocardiographically the recognition of a normal electrical behavior of the heart is more complex. Thus, the numerous electrocardiographic facets of normalcy can be simply visualized as caused by altered orientation of a normal cardiac vector in regard to a fixed lead system. Similarly, deviation from its normal characteristics can be ascribed to specific pathological entities. The analysis of even complex electrocardiograms offers few difficulties when the spatial vectorcardiogram is available.

Caution should be applied to continued usage of the terms "intrinsic" or "intrinsicoid" deflections. With our present state of knowledge, it cannot be considered a signal of the arrival of the excitation wave in the area under the exploring electrode, but a representation of the turning point of the cardiac vector in relation to the line of derivation of the lead employed.

The stimuli provided in recent years to extend renewed investigations in the varied foun-

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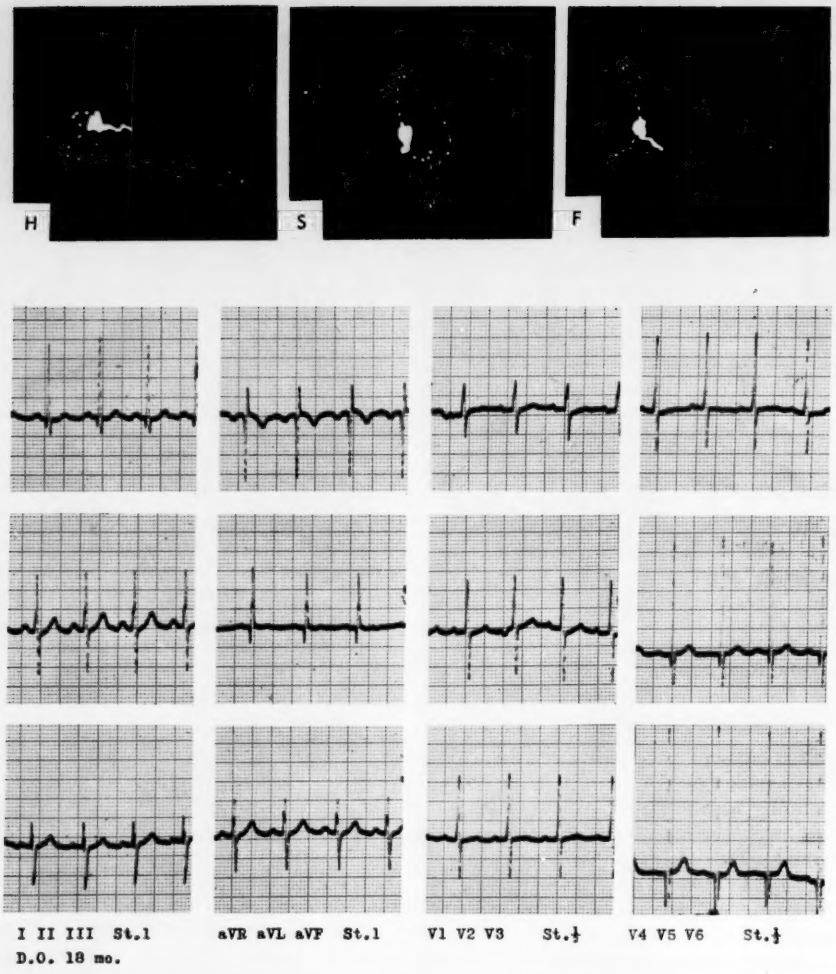

Figure 5. *Combined right and left ventricular hypertrophy. In the horizontal (H) plane projection, the terminal loop is clockwise inscribed. In the frontal (F) plane, the QRS vector is almost horizontally oriented with counterclockwise inscription.*

dations of experimental and clinical "electrocardiology" are going to provide many new thoughts, approaches, and facts. Vector integration, under investigation in the authors' and other laboratories, will lead to many new ideas in regard to spatial analysis and quantitation of changes.

A theorist's approach alone to vectorcardiography does not appear to be a productive one. With the information derived from the spatial vectorcardiogram for clinical purposes, the available techniques—in the authors' hands the "cube" technique of electrode placement (fig. 9)—have proved reliable and most adequate. Refinements proposed have emanated from investigators who were not adequately aware of the scope of information desired. For the biological variations encountered, the existing techniques are of ample exactness.

It is felt that the sources of error and deviation from the major concept (and technique) are insignificant, and therefore there should be no deterrents to its application to clinical practice.

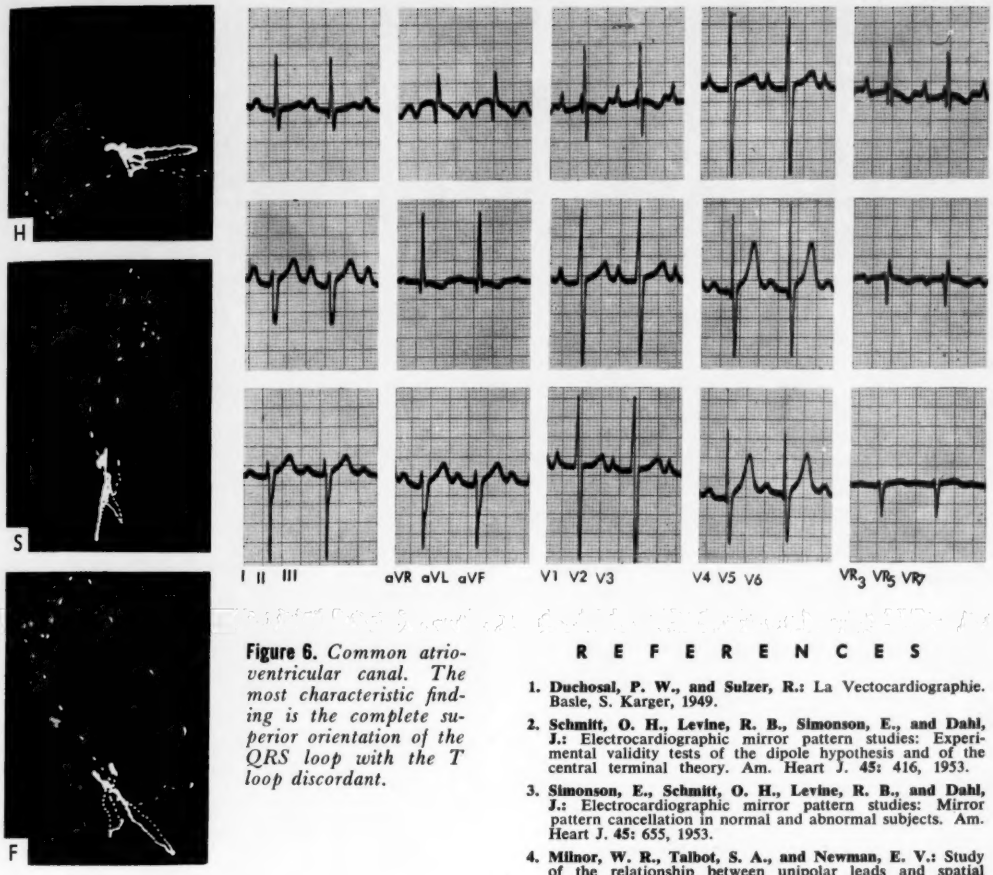

Figure 6. *Common atrioventricular canal. The most characteristic finding is the complete superior orientation of the QRS loop with the T loop discordant.*

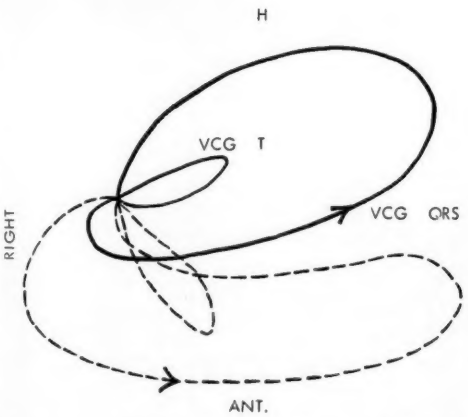

Figure 7. *In infarction of the posterior aspect of the heart, the QRS loop will be displaced anteriorly (anterior predominance). (Normal)————————; (Infarction) — — — —.*

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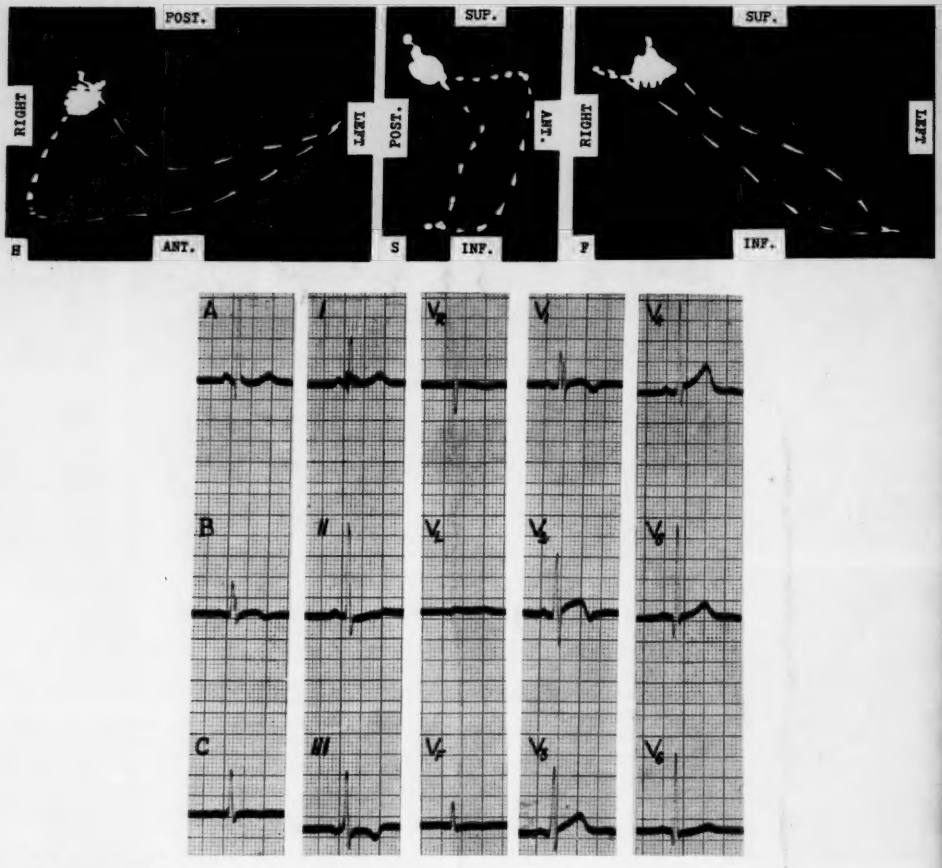

Figure 8. *With QRS loop displaced anteriorly, due to posterior wall infarction, high R waves will be seen in V_1.*

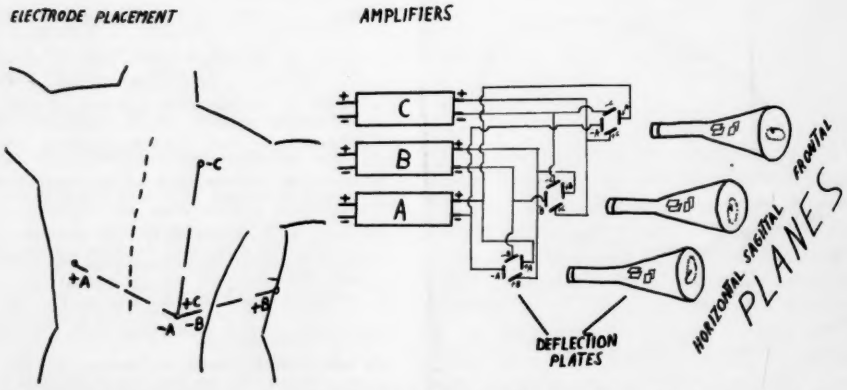

Figure 9. *Lead placement as employed in the "cube" technique. Three bipolar leads, A, B, and C, are arranged at right angles to each other. The horizontal plane is obtained through the appropriate connection to the oscilloscope of leads A and B; B and C for the sagittal; and A and C for the frontal plane.*